



SIGNAL

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Since 1996

de N1NC

September 2019

Volume 28 Number 9

In this Issue

- Rod, WA1TAC relates his design and construction of a 2-meter Yagi2
- Bruce, K1BG, answers another question about Contesting.....4
- Dan, KW2T, continues his discussion of building a 100W 6meter amplifier4
- Your editor reports on an expedition to one of New England's hidden retail electronics treasures.....6

This Month's Meeting

At the September meeting (7:30pm, September 19):

- Bruce, K1BG, will speak on the CWOPS CW Academy.
- Jim AB1WQ, will summarize some of the individual QSO totals, conduct the promised lottery, and present the FD Coordinator's awards: The Kilowatt Award, and The Most Valuable Ham (MVH) Award.
- John, KK1X, will distribute Field Day pins to those who ordered them.

From the President de Stan, KD1LE

Well here it is September already and if there is any doubt, the evidence is clear in nature with the first trees starting to change.

I hope everyone had a great summer. It is not too soon to start and/or finish those outdoor projects like antennas and tower work. If the latter, be careful and ask for help if you need it.

Boxboro

With September comes Boxboro Oops; excuse me, that's The Northeast HamXposition 2019. (Boxboro was easier to say.)

I don't usually do many of the Friday sessions, but this year there were a number of them related to EMCOMM and in particular an early one on the New England Forest Rally¹, presented by Tim, W3ATB. Amateur Radio volunteers provide health & safety communications for the rally, which is a high-speed automotive race through the outback. There are no paved roads, power or phone (landline or cell) and the courses stretch over distances sometimes greater than ten miles with significant terrain issues for line-of-sight propagation. 2m communications are limited to simplex due to the lack of nearby repeaters. The rally takes place over two days on multiple courses. The conditions are somewhat difficult and the rally organizers are primarily looking for experienced volunteers.

The volunteer operators can be multiple miles apart on the course and are critical for safety. The organizers had been using just two-meter simplex which has significant challenges, but are beginning to bring on HF to address this.

I was only familiar with the rally because Erik Piip KA1RV, a past NVARC president, used to participate in it. Beyond that I didn't know much. So, I was incited to attend Tim's session.

¹ (<http://www.newenglandforestrally.com/>)

A Two Meter Homemade Yagi
de Rod, WA1TAC

Tim followed up with a presentation on the "Climb to the Clouds" race, which is somewhat similar to the Forest Rally, except that the race is from the base of Mt. Washington to the summit on the auto road. These rallies happen in August but not every year.

Anyway, that got me in the door at the Hamvention, and I found a full day of sessions to keep me busy. I found a couple more for Friday morning and only took a short break for lunch. I was a little skeptical of my afternoon choice as it was from 1 PM to 5:30 PM on Winlink and NBEMS.

I knew something about Winlink, and I had heard mention of NBEMS, but otherwise it was just some mysterious five letter acronym.

It turns out it is all about Fldigi, which most of you are probably familiar with. It has a couple of companion programs that take the signal from a multi-mode sound card modem tool to an integrated package adding some forms of error correction, and a lot of message and forms handling. Using standard forms like the ARRL Radiogram, ICS-212, ICS 205, and various other served agency forms used by Red Cross and SATERN. It allows the filling out of a document at one end, sending only the added content and recreating the entire formatted document at the other end in the format served agency expects.

On Saturday I attended the New England Section Emergency Coordinator Forum. It was interesting to hear what the various Sections around New England are doing to improve the ARES organization, training, and relationship to supported agencies.



Looking Forward:

I hope everyone is ready for an interesting year.

We are exploring doing an Amateur Radio activity for the Boy Scout Jamboree on the Air with Owen, KC1KCT, who is a Boy Scout from Ayer. Owen is working on whether arrangements can be made with the Boy Scout Council leadership. Possible locations at this point are the Lancaster Boy Scout office (where we set up two years ago) or Pearl Hill State Park in Townsend during a camporee.

Stay tuned as we will need some help for this.
de Stan KD1LE

A recent addition to the author's ham shack was a low power transverter for two-meter SSB. Previously, only FM was used on this band using a Ringo Ranger vertical antenna. Since horizontal polarization is the standard for both SSB and CW, a different antenna was deemed necessary. A brief search through the basement ham junk box uncovered sufficient material for a small Yagi and the project entered the detailed design phase.

The gain of a Yagi antenna is more limited by boom length than the number of elements, and the 45 inch section of EMT found in the junk pile was only long enough to support a three element Yagi, given that the proper way to mount the boom of a VHF Yagi to the support mast is from behind the reflector element as opposed to the middle balance point as is customary with HF Yagis.

Hence, a three element Yagi was chosen.

Aluminum tubing, one-half inch diameter, was available for the elements, and a resonant frequency of 144.5 MHz was desired. Reviews of antenna books and internet articles resulted in the following element lengths being selected:

Reflector	40.5 in.
Driven Element	38.4 in.
Director	36.6 in.

There was only loose guidance on element spacing; hence, the reflector to driven element spacing and driven element to director spacings were chosen to be 13 and 14 inches respectively. Adequate boom length exists to increase these spacings later.

Rectangles of plexiglass were used to mount the elements to the boom. Standard U-bolts secured the plexiglass to the boom and two 6-32 machine screws bolted the elements to the plexiglass via two holes drilled through each element.

A rectangle of aluminum plate was used for the boom to mast bracket along with U-bolts.

A gamma match was selected to match the low impedance of the Yagi to standard 50-ohm coaxial cable.



The Gamma Match

The author had previous experience successfully implementing a gamma match on a 6-meter beam; hence its selection.

An 8 inch section of the half inch tubing cut off to make one element formed the outer part of the gamma match capacitor and the inner conductor and dielectric from a piece of RG-214 coax cable formed the inner part of the coaxial capacitor.

Two adjustments were available; the attachment band from the outer capacitor tube to the driven element and the length of overlap of the outer and inner capacitor conductors. A thin aluminum strap connected the gamma match to the driven element; the spacing was one inch.

An angle bracket was made to mount a female N-connector to the plexiglass rectangle holding the driven element. The socket provides the attachment point for the inner part of the gamma match capacitor. A short aluminum strap was used to connect the N-socket to the center of the driven element.

At VHF and higher frequencies, N- connectors are preferable to UHF connectors because they show constant impedance. Plus, they are more weather proof. Here is the completed beam:



The completed Beam

The antenna was mounted on a 10 foot section of mast for testing:



On the Test Range

An MFJ-259 antenna analyzer initially showed that the driven element was too long (the resonant frequency was 143 Mhz). Hence, an eighth inch was removed from each end of both the driven element and director.

Note: The element lengths given above are the final lengths. This change increased resonance to 144.5 MHz, the lower end of the band. Trial and error adjustments of gamma match lowered the VSWR to !.2:1 over the bottom MHz of the band. Success was declared.

Because building materials were available, the cost of this project was quite low; the only purchased items were the 16 U-bolts. The use of both a small drill press and band saw simplified the construction process although a hand drill and hacksaw would

work. A sheet metal brake was used to make the brackets. Small construction projects such as this antenna are an enjoyable part of the amateur radio hobby.

de Rod, WA1TAC

On Contesting
de Bruce, K1BG

Here's another question I've received on contesting:

Q "How do I log without using N1MM?"

A: How do you log now? If you keep a log (paper or computer), that way still works! The main reason people want to log is to either have a basic record of the contact (for their log, chase awards, QSL, whatever), or submit a score for the contest (and a contest logging program like N1MM+ works great for this). If you're not submitting a score, it really doesn't matter. Simply keep an entry in your log (whether it's paper or computer) and you are DONE. Some contests still allow paper entries, but you will need to be able to review your logbook in order to get the info for the score you are reporting. Check with the sponsor of the contest to see what the requirements are.

If you have any questions, please direct them to me at bruce.blain@charter.net.

73, de Bruce, K1BG

A 6 Meter 100W Amp
The Easy Way – Part Two
de Dan, KW2T

Last month I talked about building a 6 Meter power amp, using the new MRF101 transistor, which will give us 100 Watts of power with 1/2W drive, and you can buy the kit from NXP for \$50. This month I'll talk about one of the additional parts of the amp you have to build outside the kit, which is the output low pass filter.

First, the purpose of the filter is to remove the harmonics that are generated in the power amplifier. The FCC requires radio signals to be relatively clean, and for 6 meters, the rules say (97.307e) for transmitters in the 30 - 225 MHz range and over 25 Watts, any spurious emissions shall be more than 60 dB below the main signal.

If you had a time machine and could build this amp before April 15, 1977, you wouldn't have any restrictions on the output and you could forget this filter. If you want to FCC certify this amp so you can

market it, you'd have to kill any gain in the CB band, which this probably has. That would be another kind of filter.

So how bad are the harmonics from this amplifier? It depends a lot on how you run it, how high the power supply voltage is for what power you're trying to get out of it, how clean the signal coming in is and things like that. The truth is, I didn't measure it yet, so I don't really know.

But my guess is they are already down quite a bit, maybe 30-50 db. Also, if you look at a lot of commercial amplifiers for 6 meters, they all seem to have a 3 or 5 pole filter on the output, which controls how much you attenuate harmonics, so I'm going to take an educated guess and just build a good 5 pole filter for this thing. I'll tell you if it was a good guess when I get this all working together.

So how do you design a filter like this? These filters are just LC circuits, and like all such nice linear circuits like that, you can do some circuit analysis and come up with a frequency response. In general, if you want a low pass filter like we do, you want inductors in series, and capacitors shunting to ground. So, if you draw up such a circuit with 5 components and write up the equations, you'll find there are a zillion possible solutions, each giving you different kinds of frequency response shapes.

As you might have guessed, people have worked on this a lot in the past and come up with some pretty cool solutions. If you are any kind of RF engineer, you have this big red book on your shelf written by Zverev. It was published before there were any good computers out there, and has design information for lots of kinds of filters, with huge tables in it you can use to get component values for your frequency and response shape and impedance.

Today you can do what every kid knows how to do and just go to the internet and type "filter design tools". One of the hits you get is a place called RFTools that has a really good program that I used for this, so I don't really need my big red book anymore, but I did use it once in 1979 to design a rather complex filter.

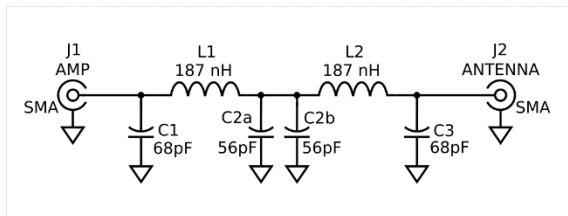
One of the guys working on this problem a while ago was named Pafnuty Lvovich Chebyshev (1821-1894). He came up with the mathematical polynomials which describe this odd result if you solved the filter circuit for the ripple in the response curve, and set that to a constant. The equations ended up using one of those cool functions you find on big scientific calculators that you never used, the hy-

perbolic cosine. He had no idea these would help design filters at the time, he was just playing around with mathematics.

There are about 5 other major filter solutions by other famous people that make filters that are good at other things, but this one is probably the best for what we want here. RF people would argue that point with me, but this is my design, so this is how we're doing it. If you want the long story, ask me sometime.

With the RFTools software website, <https://rf-tools.com/lc-filter/>, you tell it you want, Lowpass Chebyshev, and a corner frequency where you want it to start attenuating (from there on up in frequency), and you tell it 50 ohms, and then you specify a ripple for the Chebyshev solution, and you hit Compute and it does it for you. Then you have to play around with values some and get it to give you component values that you can actually buy.

To make a long story short, if you set the frequency to 57.7 MHz and the ripple to 0.14 dB, you get a design with some nice values. See the schematic below:



You're not done yet, something you should really do is simulate this in some other software like LTSpice, and verify a few things:

- 1) Does it roll off too soon and attenuate inside the 6m band? Not only does that eat power, but the filter will get hot.
- 2) Does the impedance through the filter in-band look good? If it doesn't, you may make your transistor oscillate and blow up.
- 3) What's the maximum voltage on any of the caps with 150 W? Don't want to blow up caps.
- 4) What's the maximum current through any parts with 150 W? Don't want to blow up caps or inductors.

I drew it up in LTSpice and ran it, and with 150 Watts going into it, I see the highest voltage on the center cap, and it's 116 V_{rms} (165 V_{peak}). The high-

est current is also in the center cap to ground, and it's 4.4 Amps at the high end of the band.



LPF Frequency Response via LTSpice



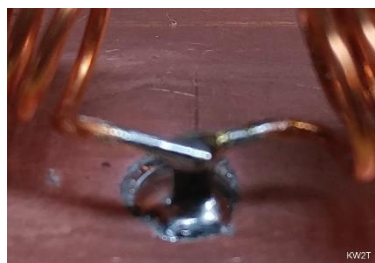
I bought caps that are rated at 600V, and on the middle cap with all the current, I put 2 in parallel. Which works out great for hitting the value I need.

These are 1206 size surface mount parts: real small. The Inductors are 7 turns #20 wire wound on a 0.234 drill, spaced out as shown.

I built the filter on a piece of solid copper PCB material. Maybe some day I'll lay out a board as part of Tech Night Radio One we are working on.



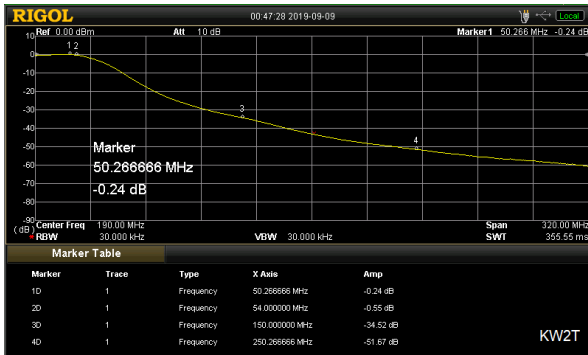
I soldered an SMA connector and it's capacitor on each end,



soldered the caps standing up in the middle, wound some coils, and bent them to the right value in between.

Done.

I put the filter on the analyzer with tracking generator that I borrowed from work, and here's the plot:



Measured LPF Frequency Response

It's looking as expected from the simulation: Marker 1 is at 50 MHz, and is down 0.24 dB; probably as good as it's going to get. At the high end of the band it is down 0.55 dB, about as predicted.

Really, I should have put the corner frequency out a little further and these would be a little better. Maybe I'll spread the coils out a little which will shove it up some.

The 3rd harmonic at 150 MHz is down 34.5 dB, and the 5th is down 51 dB. This is not as good as the simulation, which said 45 dB and 70 dB, and the RFTools prediction was even lower.

If you look at the slope measured, it takes a corner to a slower roll off around 100 MHz. Don't know for sure what's causing that, but a likely culprit is that the two coils are coupling together. It's important that these two don't do that. Maybe later I'll try a different layout with the coils further apart or at more of an angle to each other. But this will do for now, until I see what I really need by running the amp through this.



How do filters work anyway? What do they do with those harmonics you don't want? Where does that energy go? Well, this is bad news.

What it does is make the 50 ohms look awful, so these things get reflected back at the amplifier. You can build a real fancy filter that gives these things a resistor to dump into, but it gets really complicated fast.

Realize that with a good amplifier like this one, the harmonics are already down more than 20dB, that means they are only 1 Watt at worst, with 100 W coming out at 50 MHz. Most likely they are way less than this. So, reflecting them back into the amp

and letting it deal with them somehow is not such a bad thing. Keeps them from getting on the air, which is what we need to do.



In Part 3 I'll talk about how to power up the amplifier with a bias supply. This is where most people screw up and blow up the part. It's really easy to do. So, I'll tell you how NOT to do that. Then Part 4 will be putting it on a heat sink and final performance tests. Stay tuned.

NOTE: When you buy the kit, it does not include the 12-15 parts needed for 6 Meters. I have 3 more sets of these parts left if anyone wants to build one of these. The cost of the parts is that you have to show up at TechNight, and you need to actually use them and not sit on them for a year.

de Dan, KW2T

Around & About de KB1HFT

Over this past month, your Editor has explored a few places that may be of interest of readers of the Amateur Radio persuasion.

An expedition to Manchester's Electronics Superstore: "Electronic Surplus Services, Inc." was mounted last week by your Editor, KB1HFT; Stan, KD1LE; Bill, AB1XB; and Bob, W1XP. The "Superstore" is a re-seller of new and used going-out-of-business inventory and the like. They have been in business in Manchester in at least two locations over the past 20 or so years, and provide a wealth of you-didn't-know-you-needed-it stuff, as well as a wealth of you-didn't-know-where-to-get-it stuff!

Their inventory is an always evolving mix of excess electronic, & electric equipment, as well as laboratory & industrial supplies and tools. Where else within driving range can you find 24 different types of toggle switches?

The management has a unique sense of humor. Signs are posted all over, instructing the customer on correct protocol:



Here's a spotless, HP 19" rack, with roller slides: only \$45 !!

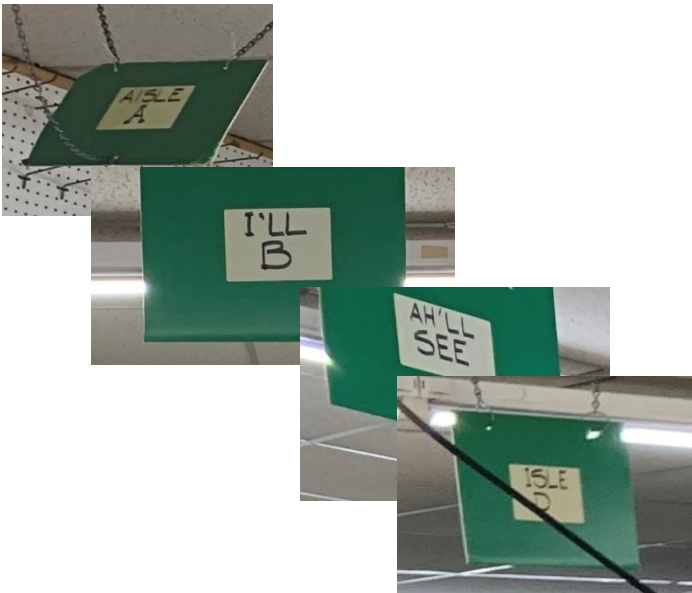


A wide selection of DC power supplies:



Dozens of sizes of shrink tubing:

Unique signage:



All in all, it's a fun place for Hams to visit! Check them out: 900 Candia Rd, Manchester, NH 03109



More recently, the Northeast HamXposition was, to my thinking, the most satisfying Boxboro event in several years.

I go mainly for the flea market, but this year there were several forum sessions that piqued my interest.

John Salmi, KB1MGI, spoke on RF Fingerprinting which he has studied in order to assist in identifying misbehaving lids that intentionally QRM repeaters. John has worked with the FCC to identify several evildoers. John also shared a link to a YouTube video that was made inside an FCC investigator's vehicle, with the investigator demonstrating his equipment. The link is:

<https://www.youtube.com/watch?v=QIGAOLJh-XE>



Perhaps the threat of rain kept many flea market vendors away: there were perhaps only 1/3 as many as in years past. However, the selection of RF goodies was, as usual, exceptional.



Notable this year were several organizations hosting Build-A-Thons.



de KB1HFT



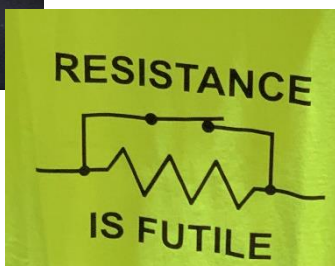
Bill, AB1XB, has informed us of an interesting article on the Apollo Guidance computer's switching power supplies that are still reliable after all these years. Click [here](#) to view the article.



Ralph, KD1SM, reports that quite a few NVARC members were seen at "Boxboro":

Jim, AB1WQ; Bill, AB1XB; Jean, K1AVM; Bruce, K1BG, Dennis, K1LGQ; Skip, K1NKR; Bill, K1NS, Jim, K1PTF; Dan, K1RAU, Andrew, KA1GTT; Karen, KA1JVU; Peggy, KC1EIV; Owen, KC1KZT; Stan, KD1LE; Ralph, KD1SM; Lynda, N1PBL; Jeanine, N1QIT; John, KK1X; Phil, W1PJE; Bob, W1XP; and Rod WA1TAC.

Your Editor, KB1HFT, also attended, as did Les, N1SV, and probably several others. What a turnout!



Calendar

All Year

WA1WCC celebrates 100 years of RCA

WA1WCC is commemorating the founding of RCA in a year-long celebration. Watch for WA1WCC/100RCA on the bands during 2019. Participants can request the RCA Special Event Certificate.

<https://ema.arrl.org/2019/01/19/wcc-ara-celebrates-rca-centennial/>

September

15 Flea at MIT. <http://www.swapfest.us/>

de Stan KD1LE

October

5 Yankee Steamup: "New England's Oldest Engine Show" New England Wireless & Steam Museum 1300 Frenchtown Road • East Greenwich • RI 02818

<https://newsm.org/steam-up/>

11-12 NearFest <http://www.near-fest.com>

20 Flea at MIT. <http://www.swapfest.us/>

NVARC Swap Shoppe

The following items are available for a donation to NVARC. Monies to be paid to the Treasurer. Items to be picked up from me.

- As listed in my column a Kenwood TM-D700A dual band radio body \$25
- An almost complete Kenwood TM-D700A with remote adapter panel but no serial cable or microphone \$45
- MFJ 944 Versa Tuner II \$20
- Henry Electronics two-meter amplifier 1 to 5 watts in 80 watts max out \$25
- KLM 10-70B two-meter amp 10 watts in 70 watts out \$25
- Ranger Communications RCI-600 VHF/FM Marine Radio with microphone. Looks brand new/unused \$45
- Stanley Electric pencil sharpener \$5
- Velleman VTSS5 soldering station \$5
- GE External speaker \$5 (there are two)
- Yaesu FT 7800 with Kantronics 3+ attached \$40
- Yaesu FT 7800 marked "hot on transmit" \$5
- MFJ 12728BX mic/tnc switch \$5
- MFJ 12738BTV mic/tnc switch \$5
- HP V1905-24 POE switch \$50
- Regency ARU9PLRH606B don't know what it is, but it has a nice heat sink, looks like a VHF transceiver vintage \$10
- MFJ Versa Turner II MFJ-949E \$50
- LINKSYS WRT54G, BEFSR41, BEFW11S4 \$5 each

Board Meeting Notes

Attendees:

Stan, KD1LE	Jim, N8VIM
John, KK1X	Bruce, K1BG,
Ralph, KD1SM	Ed, N1YFK
Jim, AB1WQ	Owen, KC1KCT
George, KB1HFT	

- Bruce, K1BG, will speak at the September meeting on CW ops.
- October meeting is open.
- November meeting will be the annual Card Sort.

- December meeting will be Homebrew Night.
- January: Short Subjects
- Feb & Mar are open.
- The Board is considering joining with the Boy Scouts for an event in the fall. Owen, KC1KCT to coordinate.
- Field Day accounts have all been settled save the PortaLet bill.
- Jim AB1WQ will present FD stuff at the September meeting.
- Talk of making radio courses available to the community.
- Quote for 72 coffee cups came in at \$231 - will be going to membership for approval.

de John, KK1X

Elmering

If you know of a young person who has recently become licensed, or who might be interested in becoming a Ham Radio Operator, and is in need of equipment to set up a station, an NVARC member has the resources to assist.

Through the generous donation of a fellow ham, he can supply the hardware and setup know-how to get a young-un up and on the air. If you know of such a person, please contact Jim, N8VIM at: N8VIM@arrl.net



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President: Stan Pozerski, KD1LE

Vice President: Jim Hein, N8VIM

Secretary: John Griswold, KK1X

Treasurer: Ralph Swick, KD1SM

Board Members:

Jim Wilber, AB1WQ, 2016-2019

Ed Snapp, N1YFK, 2017-2020

Bruce Blain, K1BG, 2018-2021

Property Master: John Griswold, KK1X

Librarian: Peter Nordberg, N1ZRG

Emergency Coordinator: [open]

N1NC Trustee: Bruce Blain, K1BG

Join NVARC! Annual membership dues are \$15;
\$20 for a family.

Meetings are held on the 3rd Thursday of the month at 7:30 p.m. in the Pepperell Community Center.

Contact us on the N1MNX repeater.

442.900 (+), 100Hz

147.345 (+), 100 Hz

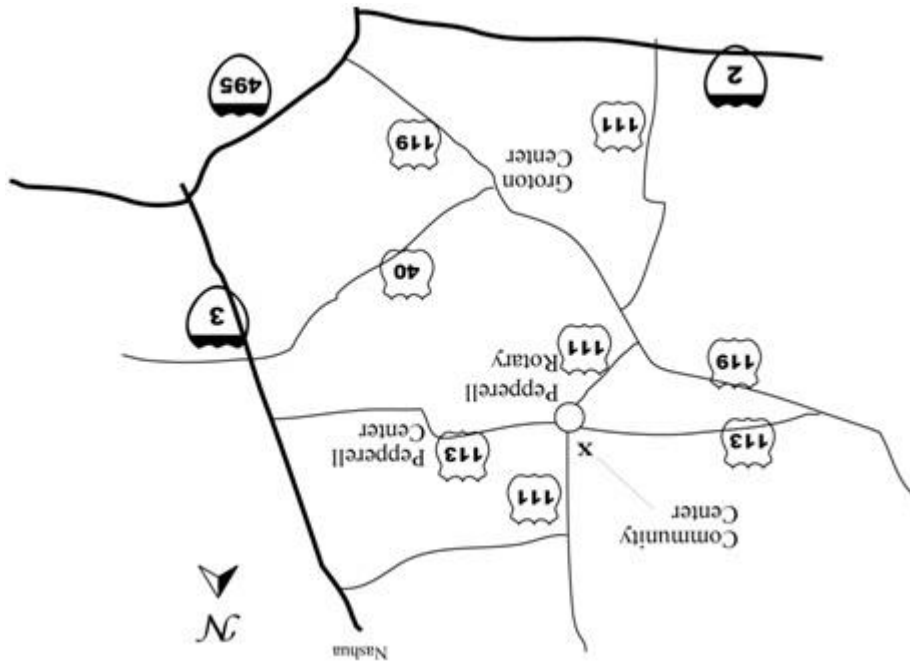
53.890 (-), 100Hz

This newsletter is published monthly. Submissions, corrections and inquiries should be directed to the newsletter editor:

editor@n1nc.org.

Articles and graphics in most PC-compatible formats are OK.

Editor: George Kavanagh, KB1HFT



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